

WOMEN, SCIENCE, AND CULTURE:*
A course for first-year women and minority students in SEM

Sandra Cooper and Judy Meuth

Washington State University
Pullman, Washington

INTRODUCTION

As a mathematician and a scientist, we have watched the low numbers of women and people of color in our fields dwindle as they move from introductory courses to graduation. We've heard many personal stories of the difficulties of being a member of an under represented group in science, engineering, and math (SEM). The literature supports what we've seen and heard listing the problems of isolation, fragile self-confidence, relatively low computer skills, little connection between the classroom and "the real world," lack of role models and mentors, competitive environments, and the subtle and blatant discriminatory comments and acts that both groups of students face in sometimes different ways^{1, 2, 4, 5, 6, 7, 9, 10, 11, 13, 14, 15, 16}

We have confronted the attrition of women students in several ways. One of us has been teaching in the Women's Studies Program for seven years, encouraging women to pursue non-traditional fields and introducing an upper-level seminar entitled *Women and Science*. One of us was a founding member ten years ago and is presently coordinator of Women in Math, Science, and Engineering (WiMSE) at Washington State University (WSU). On our campus, WiMSE initiated a residence hall for SEM majors; an in-hall, free tutoring program; an advising fair; and other smaller programs and regular events.

Still, we wanted to address the reasons for attrition in a more direct way, and, because of the importance of first-year college experiences in determining whether students stay in science fields or not^{3, 8, 16}, decided to target first-year women and men of color pursuing an interest in an SEM major. Our approach was to design a course for these students with the goal of laying a foundation that would support their success and persistence in SEM majors.

Specifically, the course, *Women, Science and Culture*, was designed to meet several objectives. We wanted the students to

- increase their self-confidence,
- learn about and meet role models and mentors,
- recognize barriers in SEM as external to themselves and not personal shortcomings,
- explore the ways cultural socialization impacts women and men,

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- understand the history and culture of science and the practice of science around the globe,
- work with concepts and use lab equipment in several SEM fields,
- hone computer technology skills, and
- plan for their own route to a professional position in SEM.

FORMAT AND CONTENT OF THE COURSE

The development of the course and the first two offerings have been funded by the National Science Foundation (NSF) and three WSU colleges as part of Project EFFECT (EFFECT is an acronym for Equation For Future Equity in Curriculum and Technology). In addition, our WSU team was extremely fortunate to be able to attend the Curriculum Reform Institute through the University of Wisconsin Women in Science Program in June, 1997 on the UW Oshkosh campus. The Institute, which was also funded by NSF, allowed us to devote a week to planning the objectives and format of the course and exchanging ideas for content and methods with participants from SEM and Women's Studies departments from across the country.

The resulting three-credit course meets for two fifty-minute discussion periods and one three-hour lab per week. We place the students in an active role every class period; they are involved in discussion, activities, or labs; as a result, there are no lectures. Instead, the course uses readings and discussions, exercises, case studies and SEM labs, computer technology labs, special events, and a student final project to facilitate student learning.

In most of the one-hour class meetings, the class discusses topics and questions raised by the readings, the student research projects, special events on campus related to women and science, homework exercises, labs, and in-class exercises. Every student is expected to actively participate in discussions. Each day, one or more students come prepared to begin the discussion on a reading.

Exercises are used to get students involved and thinking in class and to have them research and/or reflect outside of class. Exercises include an autobiographical sketch, literature searches, data collection, data analysis, examination of the scientific method through experimentation and critique, assessment of the effects of particular technologies, responses to special events, and synthesis papers.

An important component of the course is case studies of current or historical women in SEM. Each case study is the impetus of a lab based on the work of the highlighted woman. The case studies and labs are developed and led by WSU female faculty members in the same fields as the subjects of the case studies. In this way, students are introduced to two role models and a possible mentor. They also have the opportunity to do hands-on work in a number of SEM fields. Case studies this past semester focused on physics educator Lillian McDermott, nuclear chemist Darleane Hoffman, biochemist Gertrude Elion, hydrogeologists Shirley Dreiss and Mary Anderson, and mathematics and computer science pioneers Ada Lovelace and Grace Murray Hopper, as well as generations of Native American women inventors. We will continue to invite additional faculty members to develop case studies and associated labs for the course. Each semester, we will utilize approximately six case studies from our growing bank of studies.

When students in lab are not engaged in SEM work, they are working in the computer lab. These computer technology labs are designed to enhance students' skills and knowledge of programs.

Students complete an internet research project, create a brochure in Word, enter and analyze data in Excel, and prepare a final project, among other assignments.

In addition to the two texts, readings for the course are taken from many sources that are placed on reserve for the students. Students also locate a number of readings on specific topics through reading research assignments. Sources include histories of science, anthropological studies, women's studies texts, sociological and feminist critiques of science, profiles of women scientists, and journal articles. At every class meeting, students are responsible for assigned readings and being prepared for discussion, associated lab work, or unannounced quizzes.

At the beginning of the course, students read of historical and current men of color and women in SEM and search the internet for more information about them. Students then study the social and scientific construction of gender and race in numerous cultures. To understand the effects of the culture of science on women and people of color practicing science, students read analyses of the history of women in science and study the personal stories of women presently working in SEM. Students then analyze the history and culture of science itself with readings such as Carolyn Merchant's "Dominion over Nature," Ivan Van Sertima's "The Lost Sciences of Africa," and Linda Shepherd's "Subjectivity." Students step beyond science to explore alternative methods for constructing knowledge, including a spiritual view of the universe called "deep ecology" and a Native American approach to truth. Students next find readings which discuss the effects of science and technology on groups of people, the earth, and other entities. Finally, the students revisit the stories of men of color and women working in SEM to discover the varied strategies used by them to succeed in their fields.

The final project requires students to synthesize knowledge gained through the course with their own long-term goals in SEM. Students draw on their understandings of the SEM climate, potential barriers, and ways to navigate past the barriers, to predict obstacles they might personally face and to devise strategies for success. From research on professional positions of interest to them, they determine the education and other preparation necessary for those positions. They hypothesize an ideal work environment and determine several real employment possibilities. Finally, they create plans to weave their future professional and personal lives to allow a balance they would deem satisfactory.

Throughout the course, we capitalized on special events relating to women and science at both WSU and a neighboring university. A sampling of the events students attended this past semester are *Miz Wizard's Science Secrets*, a Jane Curry performance highlighting historical women in science and science's view of women; an informal discussion with Mary Good, former Under Secretary for Technology for the U.S. Department of Commerce; a one-woman show depicting Rachel Carson; and a lecture on the multicultural roots of science by Sandra Harding.

COURSE APPROVAL PROCESS

Since the approval process is similar at most universities we thought it would be useful to mention some details from our experience. First of all, the timeline drove the whole process. The grant was awarded with a start date of July 1, 1997. The plan was to develop the course over the 1997 summer months, to gain the university sanction during the Fall 1997 semester, then offer the pilot during the Spring 1998 semester, revise the course over the 1998 summer, then run the first permanent section in Fall 1998.

We were fortunate to get a head start on developing the course since, as mentioned earlier, we participated in the Curriculum Reform Institute at UW Oshkosh in June 1998. We returned to WSU with a rough syllabus, confirmation that our idea held real promise, and lots of enthusiasm for the work ahead. We continued the development over the summer, but also started working on gaining university approval for the course. In researching the process, we received the excellent advice to find a niche for the course that would satisfy one of the university's general education requirements (GERs). The designation we sought was an Intercultural GER which meant revising our course somewhat to fit the requirements for that designation. However, it strengthened the course by allowing us the opportunity to compare and contrast the history, culture and practice of science in the western world to that in other cultures, giving the students a much broader perspective on the central issues of the course. One complication though was that now the approval process involved two committees, the GER Committee and the Catalog Committee.

In September, the lengthy paperwork was submitted requesting both temporary and permanent approval. The request for temporary approval was a precautionary measure allowing us to offer the pilot even if the course was not readily approved. In October, we were notified that the course had been approved by the GER committee and was on its way to the Catalog Committee. Unfortunately, in the approval process, the GER had been changed from an Intercultural designation to a Social Science designation. This change virtually guaranteed that no engineering student would take the course since the engineering curriculum does not require a social science GER. Before the Catalog Committee had a chance to act on it, the permanent request was pulled and temporary approval was granted, implying that we could offer the pilot session for Spring 1998.

We appealed the change to the Social Science designation in early December and the Intercultural designation was granted in early January. The permanent course request was then forwarded to the Catalog Committee. They were hesitant to give permanent approval, because of the non-traditional nature and format of the course. However, after private discussions with several committee members and a meeting with the entire committee during which we answered their questions and explained in more detail the rationale behind the individual components of the course, the course was granted permanent approval in March 1998.

Approvals for both the pilot course and the permanent course were not complete in time to have the course listed in the Time Schedule of classes, which is used by students for registration. Consequently, prior to both offerings, the course was advertised through science, engineering, and math advisors, with flyers, and directly to individuals and groups of students.

THE PILOT OFFERING – SPRING 1998

In spite of extensive advertising efforts, only four students enrolled in the pilot course. After initial disappointment, we recognized that a small class might work in our favor to get candid feedback from the students and to allow us to make course modifications based on that feedback. All of the students were past their first-year; one student was a biology major, one a math education major, and two were women's studies majors with interests in women's health or computer access.

Throughout the pilot offering the syllabus, exercises, and selected readings were revised. During class discussions, students gave informal input on the value of the various components and

specific assignments. In addition, the students completed surveys at mid-semester and at the end of the semester in which they rated the appropriateness of the readings, exercises, and labs for the course. They also gave qualitative comments on the individual components and the course in general. Basically, they all really enjoyed the course and felt that it was quite worthwhile.

For the students, the most exciting component involved the science labs. Students remarked that the labs were different from the majority of their prior lab experiences. Here, they were required to throw away the cookbook, to construct their own hypotheses, to tinker with variables, to build a prediction/theory based on their previous results, and to make sense of the process, not simply reach a forgone conclusion. They also felt that the in-class discussions were very enlightening.

For us, the rewards of teaching the pilot were many, including watching the students marvel over their predecessors in SEM, seeing their surprise and then indignation over their data on cultural messages about women and about men of color, hearing their studied critiques of science and its precepts, and seeing their growth as evidenced by their final projects.

THE NEXT STEP

In the process of developing and teaching the course, it became clear that there was no published text in existence that met all of the needs of the course. For the pilot session, we used portions of two texts and 48 additional readings. We will be faced with a similar situation for Fall 1998. We are in the process of seeking copyright permission for the extra articles for a reader for the Fall class. However, that is an awkward and fairly expensive route to follow semester after semester, so we have decided to write a text for the course provided we are able to secure the development funding.

The text will contain an introduction and readings relevant to each segment of the course, in-class exercises, out-of class exercises, case studies which will include background readings, fully developed labs including written assignments to accompany the labs, and computer technology labs complete with instructions and exercises.

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